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Growing PEAS

FOR Canning
AND Freezing



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PEAES are one of the three most important vegetable crops for canning in this country. Their production centers for the most part in the region bordering on the Great Lakes and in Washington, Oregon, and Utah. In addition a large tonnage of fresh peas is now preserved and sold in the frozen state. Washington and Oregon are the leading States in the freezing of peas.

Because they are legumes, peas fit admirably into a general farm rotation including crops grown for grain and forage and also certain of the vegetables. Peas may be used as a nurse crop for alfalfa and other forage crops, or they may be followed the same season with another short-season crop such as late sweet corn, late potatoes, or fall spinach.

The pea crop requires a mellow, fertile, well-drained soil. The seedbed should be deeply prepared and left with a smooth surface to facilitate harvesting with a mower. The crop, as usually grown in drills like wheat, requires no cultural attention after the seed is sown.

Peas for canning or freezing pass their prime condition within a very few days. The crop must be handled promptly, and the peas must be canned or frozen with dispatch to produce a product of high quality. Therefore, this specialized industry requires the closest cooperation between the grower and the processor.

The utilization of pea-vine refuse as feed is an important asset in dairy and stock-feeding regions.

This bulletin is a revision of Farmers' Bulletin 1255, The Production of Peas for Canning, which it supersedes. It also contains information on peas for freezing.

GROWING PEAS FOR CANNING AND FREEZING

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PEAS ARE ONE OF THE THREE most important canned-vegetable commodities in the United States, the average annual pack for the 10-year period from 1930 to 1939, inclusive, being 18,057,500 cases¹ as compared with 23,379,000 cases of tomatoes and 16,059,600 cases of sweet corn. In 1938 the pack of canned peas reached 25,459,000 cases but dropped to 16,074,000 cases in 1939 as a result of the extremely heavy pack in 1938 and a similar pack in 1937. But the 1940 pack was large—over 25,000,000 cases—and the 1941 pack was almost 29,000,000. In addition to the great quantities of peas that are canned, a large tonnage of fresh peas are now preserved and sold in the frozen state. In 1941 about 30,000 tons were frozen.

WHERE PEAS ARE GROWN FOR CANNING AND FREEZING

The growing of peas for canning was at one time restricted to the Middle Atlantic States. In some sections of these States this industry is still of primary importance, but it is now centralized for the most part in the region about the Great Lakes and in Washington, Oregon, and Utah. Wisconsin leads in the canning of peas, and New York ranks second with an average acreage slightly less than 30 percent of the Wisconsin acreage. These two States furnish about 45 percent of the canned-pea output of the United States. The geographical distribution of the industry (1925–29) is indicated in figure 1. During the last 5 years, acreage increases have taken place in Washington, Oregon, New York, Wisconsin, and Minnesota; the acreage has declined in Delaware, Virginia, California, Michigan, and Maryland. New Jersey, Delaware, Maryland, Washington, and Oregon now produce large quantities of fresh peas for preserving by freezing. Washington and Oregon are the leading States in the freezing of peas.

CLIMATIC REQUIREMENTS OF THE PEA CROP

The pea is a cool-weather plant. Not only will the seeds germinate and make vigorous growth at lower temperatures than those of many other vegetable crops, but cool weather is necessary for obtaining good yields and high quality. High temperature checks

¹ Stated in cases of 24 No. 2 cans each.

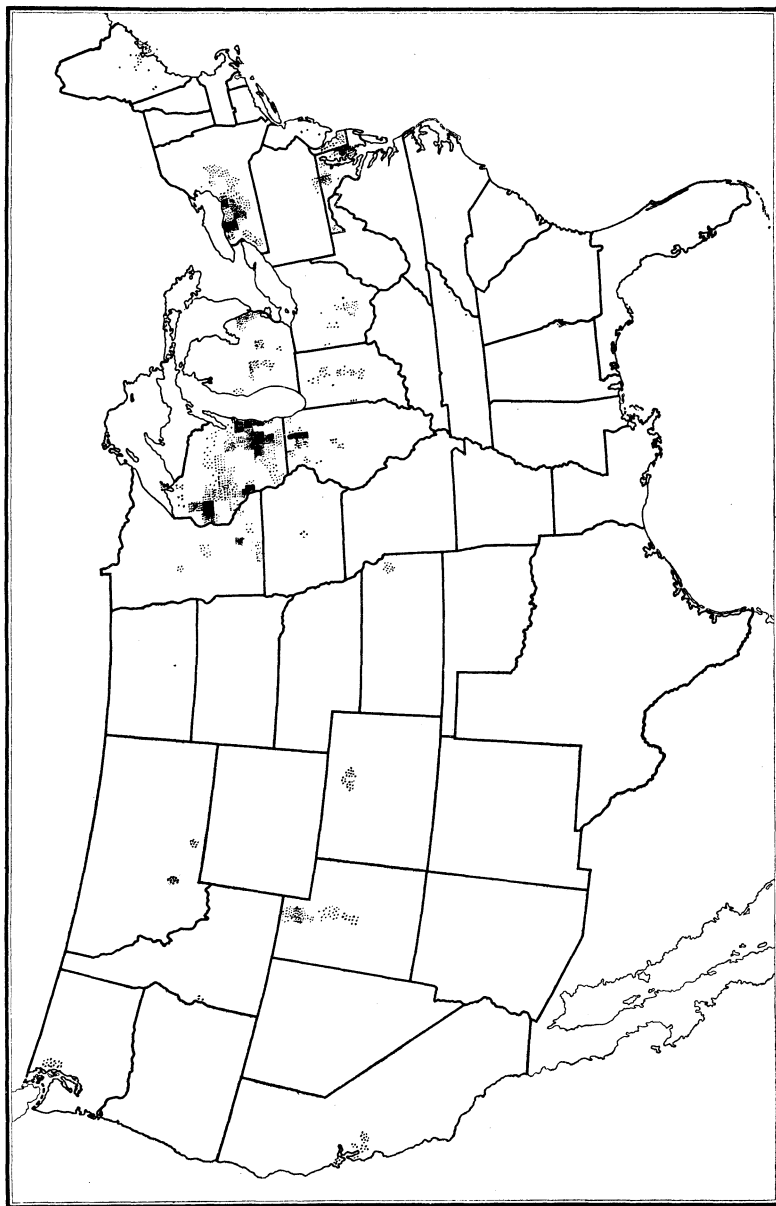


FIGURE 1.—Outline map of the United States, showing the location of the pea-canning industry for the years 1925-29. Each dot designates an average of 100 acres per year. (See p. 1 for recent changes in location of the industry.)

the growth of the plants and causes them to flower and form pods before the plants have attained enough size to bear a good crop, while cool weather permits a long-continued growth and the formation of many pods that do not reach the harvest stage prematurely.

Besides stunting the growth of vines and reducing the yield, hot weather increases the rate of maturity so greatly that it is often impossible to harvest the crop at the proper stage of development, with a consequent loss in quality of the product. The crop is grown most successfully in regions where the weather in the spring is a little slow in changing from cool to warm. The hazards of the crop are too great for its profitable production in regions not particularly suitable for its culture.

The young plants will endure some frost without serious damage, but the blossoms and young pods may be killed by a temperature that would not greatly injure the other parts of the plant.

PROVIDING SUPPLIES FOR CANNING AND FREEZING

The processing of peas is a specialized industry. For economic reasons several crops for processing are usually grown in the same vicinity. The location of a factory is determined by the prospects of obtaining the various crops to be handled at equitable prices and in sufficiently large quantities to run the plant at its full capacity for a reasonable length of time. It is essential that the crops be delivered to the factory with little delay after harvesting, in order that processed products of high quality may be prepared. Therefore, the factory must be as near as possible to the production center of the commodities to be used. Good roads are an asset for the hauling of the harvested crops. Factory labor is an important item, and usually the plant is located near a small city or other dependable source of labor.

The pea crop is usually grown under contract, the processors specifying the varieties and the acreage to be planted by each grower. In some localities the processors themselves own or lease land upon which they grow a portion of the requirements of their factories. Whatever method is employed in providing a supply of peas, the processors usually assume general direction of the crop, including the selection of the land. Many of the companies exercise the right to provide the seed. They handle these in order that the varieties planted shall be those that are best adapted to the demands of the trade. The companies grow or buy the seed and often sell it to the growers at a lower price than the original cost. An intelligent field man is an asset, for he comes in close contact with the growers, helping them to solve their problems and giving instructions as to the care and harvesting of the crop. The agent of the company examines the fields as the harvest period approaches. He directs that the peas be harvested and delivered at the most timely period, as judged by the maturity of the crop, the ability of the farmer to deliver, and the capacity of the cannery or freezing plant to handle the material. The acreage for the average grower is limited by the area of suitable soil under cultivation, the character of the equipment he possesses, especially for the harvesting of the crop, and the number of laborers available during the rush period. From 10 to 15 acres of peas will maintain a fair rotation balance for a farm of 100 acres. Some individual growers specialize on peas and grow a much larger acreage.

CROP ROTATIONS

The pea is considered an important crop in those sections where it can be grown. It makes an ideal addition to a rotation, as it is a nitrogen-gathering crop, and land devoted to it, when properly handled, increases in productiveness. However, successive plantings of peas year after year usually cause "pea-sick" soils. This fact makes it desirable that the crop be included in a farming system that will not bring it on the same land oftener than once in every 4 or 5 years.

Many growers are of the opinion that peas do best when they follow some cultivated crop that has been well fertilized. The available plant food left over from the previous crop may be of some value to the peas. These rotations are suggested:

Four-year system.—(1) Hay; (2) corn or potatoes; (3) peas; (4) wheat, oats, or barley.

Five-year system.—(1) Hay; (2) hay; (3) corn, potatoes, or cabbage; (4) peas; (5) wheat, oats, or barley.

In regions of extensive production for processing where the peas can be harvested early enough to grow another crop the same season, a rotation similar to the following may be used:

Five-year system.—(1) Hay; (2) wheat, oats, or barley; (3) field corn or sweet corn; (4) tomatoes; (5) peas followed by lima beans.

If destructive diseases are to be avoided, vetch or other closely related legumes should not occur in the rotation soon before peas.

Since the attacks of the pea louse are frequently destructive, precautionary measures should be taken. The pea aphid is carried over winter on the clovers and alfalfa. This pest subsists during the rest of the year on some varieties of clover, the various types of peas, the vetches, not infrequently on alfalfa, and doubtless on other similar crops. It would be advisable, therefore, either to arrange the rotation of the farm fields so that the pea land would not be in proximity to those crops or to harvest such crops early in the season.

In the southern part of Wisconsin ² peas are commonly planted after corn, and in other parts of the State they follow corn or are planted on a legume sod. Trials carried on for several years at the Marshfield Branch Experiment Station showed that on the Colby silt loams of that area the best results are obtained where the peas are planted on clover and timothy sod, rather than after small grains or corn. Similar work on the Miami silt loams at the Peninsula Branch Experiment Station near Sturgeon Bay showed no such important difference. The Marshfield tests also showed that peas do not have any unfavorable effect on following crops; however, peas should not be followed by peas, and it is a safe practice to grow peas on a field not more than once in 4 years.

States east of the Great Plains generally follow the Wisconsin recommendation of a 4-year or longer rotation; but in general western areas have had very little difficulty with crop rotations involving peas, and long-time rotations are the exception rather than the rule. In some areas, especially in Washington and Oregon, 2-year rotations of wheat and peas are practiced without any indications of "pea sickness." Sweetclovers or other legumes may also be introduced into these rotations without causing adverse effects on the pea crops.

² Wisconsin Agricultural Experiment Station, Bulletin 444, Canning Peas in Wisconsin.

COMPANION OR COMBINATION CROPS

The growing of peas affords the opportunity for the sowing of other desirable crops, both being planted at the same time. Some farmers advocate the use of the pea as a nurse crop for alfalfa, in order to obtain a profitable return while the alfalfa is developing. This is especially true in dairy sections, where the alfalfa will furnish material for feeding in the fall or during the following year.

Alfalfa is sown for the most part with the early varieties of peas, such as the Alaska, since this variety produces a small vine growth that does not smother the new seeding. Late varieties, such as the Perfection, are usually considered too heavy in vine growth, and, besides, they may allow only a short period for development after the harvest of the peas. Silty soils are usually unsuited to such combinations because of injury to the alfalfa by the mowing of the peas. Under favorable conditions the alfalfa is usually about a foot high when the peas are cut, and renewed growth begins immediately. Clover and sweetclover are sometimes substituted for alfalfa, while grass seed has been sown with peas to provide fall pasturage.

CROPS TO FOLLOW PEAS IN THE SAME YEAR

In many sections of the country where the early types of peas are harvested during the first part of June the land may be fitted immediately for another crop. Many growers disk the stubble on the day the pea crop is removed, in order to conserve the moisture in the soil. Along the southern border of areas where peas are produced successfully for processing, such crops as silage corn, field corn, sweet corn, late potatoes, spinach, lima beans, millet, or cowpeas are planted as soon as the land can be prepared after the pea harvest. Buckwheat, alfalfa, fodder corn, late potatoes, or late cabbage may be used in sections farther north. Late peas are generally followed by winter wheat. Some processors grow snap beans after late peas with fair success, but unless the fall frosts are unusually delayed it is doubtful whether snap beans will have a sufficient period in which to mature in the more Northern States.

INFLUENCE ON SUCCEEDING CROPS

The growing of peas exerts a beneficial effect on many crops which may follow. The disking of the pea stubble puts the soil in excellent physical condition. The growth and seeding of weeds are partly prevented by the early working of the ground, by the heavy cover formed by the pea vines, and also by the early harvesting of the crop. The growing of peas increases the nitrogen content of the soil through the action of the nitrogen-gathering bacteria when these are present in the root nodules. Some farmers have turned under a poor crop of peas without harvesting, in order to get back the value of the seed and of their labor from the increase in the succeeding crop.

Considerable attention has been given to this secondary effect. A marked increase in the yield is characteristic where grain follows peas. The increase with wheat has been noted in New York State as varying from 5 to 18 bushels per acre. Some farmers contend that the good influence of pea culture extends farther, so that a marked improvement is seen in the hay crop and in the pasturage that follows the wheat. The advantage of wheat over oats for the succeeding crop is that the

land can be fitted for wheat simply by disking, whereas for oats the land must be plowed. In some sections it is considered easier to secure a stand of clover on land on which a crop of peas has been grown.

SOILS AND THEIR TREATMENT

DESIRABLE SOIL CHARACTERISTICS

Peas succeed on a variety of soils provided they are well drained but not so porous as to lose moisture rapidly. Clay loams are ideal if well supplied with humus and lime, but the maturing of the crop is generally retarded in stiff clays. Light, gravelly soils may give a moderate yield, producing a small vine growth, with an abundance of small pods. However, the crop may mature too quickly. Unless there is a retentive subsoil the plants are likely to suffer from drought if there is much sand in the soil. On the other hand, sandy soils permit early working in the spring and respond readily to fertilizers. Muck soils produce a growth of vines that is too luxuriant and give a rather limited production of pods.

The land should be uniform in slope, drainage, and fertility, so that the whole crop will reach maturity uniformly. Peas growing in sandy or gravelly spots ripen before those in wet-clay areas, and peas in the more exposed and better drained sections will mature before those in the low spots in the field. The higher and more sloping gravelly soils are less suitable for pea growing. Southern exposures are seldom selected, because such sites tend to hasten the maturity of the crop.

The pea plant reaches its best development on rich, mellow soils of a nonacid character that are well drained but retentive of moisture. A sandy loam seems best for all early varieties, but a loam or a silty loam gives the best results with the late varieties.

Humus is usually lacking in soils that have been subjected to intensive farming for a number of years. Peas need organic matter. This material should be incorporated in the soil with the preceding crop. Ample dressings of manure or the plowing under of a sod crop will not only supply plant food but will provide humus, which will keep the soil open and mellow and assist in conserving moisture. Second-growth clover as well as the vetches and rye is a crop used for this purpose.

Peas need an abundance of moisture and do best in regions where the rainfall is well distributed throughout the growing season, with an annual average of between 30 and 40 inches. Through the use of a long taproot system the pea plant in some soils can take its moisture at a depth of 4 to 6 feet. This indicates that the soil should be well supplied with moisture and that a good seedbed should be formed, because cultivation, in the ordinary sense of a moisture conserver, is not usually performed. Next to drainage, moisture is one of the important controlling factors in successful pea production.

Drainage is one of the main points in successful pea culture, for it removes the free water, which would be harmful to the young pea plants if left to stagnate in the surface soil or the subsoil. The removal of the surplus water permits the free circulation of air and serves to dry the land early in the spring, allowing the early working of the soil. Drainage indirectly warms the soil and makes it possible to sow peas at an earlier date. Drainage improves the physical character of the soil and imparts to it the power to hold that moisture needed for the later growth of the pea plant. It stimulates deep penetration of the roots by lowering the water table,

making the plants less likely to suffer from drought. In the comparison of the yield of peas on drained and undrained land, an increase of as much as 10 bushels of shelled peas per acre has been noted where artificial drainage had been provided.

PREPARATION OF THE LAND

The preparation of the land and of the seedbed is very important and should receive the closest attention, as a fertile, deeply prepared, mellow soil is one of the essentials in successful pea culture. The pea is a vigorous, free-growing plant, the roots of which are extensive and penetrate deeply into the ground. The crop usually receives no cultural attention after the seed is sown. The operations before planting will influence, in part, the water content of the soil for the season of pea growing. The preliminary preparation, furthermore, will control the development of the root system and influence the extent of weed infestation.

The several methods followed in the preparation of the land have arisen from the varied requirements of soils that differ widely in their physical nature. The planting of peas on heavy soil is frequently delayed in the spring, because it is not feasible to prepare the land at that period. The fall plowing of all stiff soils and sod land permits the early preparation of the ground in the spring and provides a better seasonal distribution of farm labor. The exposure of these lands to the effects of alternate freezing and thawing during the winter improves the physical condition of the soil, assists in the more rapid decay of vegetable matter, and destroys insect eggs and larvae. Fall plowing is advisable in all cases where the washing of the soil is not likely to occur. With the lighter soils, such as sandy or gravelly loams, spring plowing may be better, especially when the soils are well drained. The depth of plowing will depend upon the nature of the soil and the previous cropping system. It is good farm practice to increase the depth of plowing by half an inch each season until the soil is plowed 8 or 10 inches deep. All soils should be prepared early and portions for late sowing maintained in condition until planting time. In fitting the land the top layer should be thoroughly fined to a depth of at least 4 inches. The methods employed in preparing the soil are determined by the character of the land and the equipment available. When successive plantings are to be made the prepared land should be harrowed frequently to keep down the weeds and to maintain a good soil mulch. Sometimes the land is rolled just before the sowing of the seed. Pea growers find it necessary to give special attention to the preparation of the soil to maintain a smooth surface. This is necessary, as minor elevations and depressions will interfere with the use of a mower in harvesting the peas.

FERTILIZING AND MANURING

The judicious use of fertilizers in connection with good cultural practices will usually be a distinct aid in producing a good crop of peas. In many sections where peas for canning or freezing are grown it has not been the practice to use commercial fertilizers, the growers preferring to depend on natural soil fertility and the use of stable manure. Owing to their nitrogen-gathering properties, peas may add to the supply of this element in the soil. In nearly all localities, however, moderate applications of nitrogen are beneficial, as the pea plant

needs readily available plant food that it can use during its short growing period.

The quantity of commercial fertilizer that can be profitably used on the pea crop is dependent upon the needs of the soil, the price received for the crop, and the probable increase in yield as determined from the experience of local growers. In the absence of such experience it would be a wise procedure for the grower to make experimental treatments on a portion of his pea field and plan his next year's applications accordingly. The experience of good growers indicates that the use of a fertilizer containing 4 to 5 percent nitrogen, 8 to 12 percent phosphoric acid, and 3 to 6 percent potash, applied at the rate of 300 to 600 pounds per acre, will be satisfactory. On soils particularly deficient in any one element, mixtures containing a higher percentage of that element should be used.

The fertilizer may be distributed broadcast by hand or with a lime spreader and then harrowed into the soil. However, it is usually applied with a fertilizer drill just before the seed is sown. Some drills may distribute the fertilizer so that the seed does not come in contact with it, but very severe losses in stand sometimes result from drilling in the fertilizer and the seed together. It is much safer to drill fertilizer in before sowing.

Stable manure when available may be applied to peas with advantage. Many growers prefer to apply the manure to the previous crop rather than to the pea crop. Manure mixed with decayed pea vines should not ordinarily be applied to land for growing peas, on account of the danger of spreading organisms that cause pea diseases.

LIMING

The pea is not appreciably injured by a slight acidity, or sourness, of the soil; but if the soil is strongly acid, lime should be applied to correct the condition. It is best to have the lime requirement of the soil determined and apply the quantity of lime actually needed. No lime should be necessary if the lime requirement is 1,000 pounds of limestone or less per acre. State experiment stations and many county agents are equipped to determine the lime requirement of soils and will furnish instructions on how to take soil samples to be sent in for testing.

Lime should be applied broadcast after plowing and before harrowing or disking. It may be applied to the preceding crops or immediately before preparing the seedbed for peas.

INOCULATION

The pea has the same characteristic as other leguminous plants, that of gathering nitrogen from the air and storing it up in nodules on the roots. This can take place only when certain bacteria are present. When they are absent the soil can be inoculated by either of two methods. The first is the transfer of surface soil from fields where the pea nodules are known to be present. This entails the handling of large quantities of earth and moreover cannot be recommended, because of the risk of carrying with it the organisms that cause certain pea diseases. The second method is the direct application of pure cultures of nodule-forming bacteria to the seed.

The manufactured, or commercial, nitrogen bacteria cultures are of three general types: (1) Bottled cultures in which the bacteria are grown on the surface of an agar medium; (2) finely ground peat or

humus used as a carrier for the bacteria; and (3) bacteria mixed with carefully prepared, finely ground carbon. In all cases the inoculation material should be strictly fresh, and where it is difficult to obtain dependable cultures from commercial sources they can usually be obtained from the State colleges and experiment stations.

When using the agar cultures, one should use water to wash the bacteria from the surface of the jellylike material in the form of a cloudy liquid. The bacteria, which are all on the surface, readily mix with the water. The humus and carbon cultures should be mixed with water and then sprinkled over the seed; the inoculated seed should be well stirred in order to obtain an even distribution of the bacteria. In no case should the cultures be applied in the dry form. The bacteria-treated seed should be sown immediately, as the bacteria die very rapidly if the seed becomes dry after inoculation. It should be borne in mind that treating the seed with chemicals to prevent rotting may destroy the effect of inoculation.

Inoculation often gives an increase of 100 to 700 pounds of peas per acre. Competent authorities estimate that a dollar spent for inoculating material sometimes gives returns ranging from \$15 to \$20 per acre. Two organizations in Illinois obtained an average of 700 pounds of peas per acre as the result of pea inoculation on two large tracts where such treatment was needed. In Wisconsin,³ yield increases as a result of inoculation commonly run from 10 to 20 percent on fields that have not grown peas before, on acid soils, and on nitrogen-poor soils. Inoculation also tends to improve quality, for the peas generally mature more uniformly and remain tender for a longer time.

Even on land where peas have been grown during recent years, it often pays to inoculate; but not all soils will show marked results. Soils that are already inoculated with the pea-nodule bacteria may not show any material increase when the seed is inoculated before being planted. These organisms may remain in the soil for several years. The soil may also be lacking in some properties important for the growing of peas that even the nitrogen bacteria may not supply. Well-drained soils, the lime requirement of which is low, respond more readily to inoculation than do poorly drained, acid soils. Some western soils actually show a reduction in yield of peas as a result of inoculation.

In most cases it would be a good plan to inoculate where peas are not doing well or when there is some doubt as to the presence of the proper bacteria. To ascertain the value of such an operation, leave a check, or untreated strip, beside the inoculated area and determine by actual weight of the yield of each strip the difference due to the application. Furthermore, examine the root systems and note whether there is a corresponding increase in the quantity of root nodules. Where conditions are right there will be a marked difference between the treated and the untreated areas.

VARIETIES

Peas for canning can be divided into two general classes—the smooth- or dimpled-seeded type and the wrinkled or “sweet.” Alaska, typical of the early smooth-seeded type, is the most popular pea grown for canning, but this popularity is based not on its quality but on its hardness. When planted under cold, wet conditions, not many of the early, wrinkled-seeded varieties will germinate as well

³ See footnote 2.

as Alaska. Late Alaskas, 2 or 3 days later than Alaska, achieved some importance a few years ago but are declining in popularity. Wrinkled peas can be divided into four subclasses: (1) Early, with medium-size seeds; (2) early, with large seeds; (3) midseason, with medium-size seeds; and (4) midseason, with large seeds. Next in importance to Alaska should be ranked Surprise, which belongs to subclass 1. The Surprise of today is an improvement in hardiness over the Surprise of 10 years ago. In many cases it is probable that Mardelah, Early Harvest, or Wisconsin Early Sweet has been substituted for Surprise without the knowledge of the canner. Perfection, in subclass 3, is still the most popular midseason variety, but after seasons with growing difficulties there is usually an increase in demand for hardier varieties, such as Abundance, Rogers K, Green Admiral, and Yellow Admiral. Varieties of the second and fourth subclasses have become important only during the past 10 years. Cannors wishing to pack a large-seeded early variety frequently used Thomas Laxton. Several similar varieties, such as Teton and Glacier, are now available. The canning of large-seeded, midseason varieties was first made popular with the varieties Senator and Prince of Wales, but Profusion and other varieties now have some importance in this class. In general varieties of subclasses 2 and 4 do not yield so well as those of subclasses 1 and 3, but where special markets for a large-seeded variety have been established they may be more profitable.

The advantages in growing early peas are (1) the extension of the canning season, (2) less farm labor at the time of the preparation of the soil and planting, (3) a smaller quantity of vines to be handled, and (4) less interference with other farm operations, such as haying, during the harvesting of the peas. Midseason peas average higher in yield than early varieties; but they are less dependable for consistency of yield, as they are more severely damaged by adverse weather, insects, and some diseases. Most of the increase in pea acreage during the past decade has been with the early varieties, but there has also been a sharp increase in large-seeded midseason varieties.

Pea varieties used for freezing have seed that are at least medium green in color at the harvest stage, and most of them have dark-green seed. The mature, dry seed of these varieties are all of medium to large size and green or a mixture of cream and green. It is noticeable that no smooth, dimpled, or all-cream-seeded varieties have been found satisfactory in freezing tests. As there is a tendency for frozen peas to be preferred in the larger sieve sizes, market-garden varieties have been used mostly for freezing; market-garden varieties are handled by the same type of viners used for canning varieties. Since the ratio of shelled peas to vines is less with market-garden peas and large seed crush more easily than the smaller seed generally used for canning, much care is necessary in handling the vining machinery. An effort has been made to process most of the frozen peas in such a manner that they can be sold as high-quality products in competition with fresh market peas, and this has resulted in special precautions to prevent loss of quality immediately after vining. Since the frozen-pea industry is based on quality products at present, it can afford to use varieties that produce the somewhat lower average yields associated with the high-quality market-garden varieties of peas and to take precautions in harvesting.

Thomas Laxton and similar varieties (Glacier, Teton) have been popular on account of their type of vines, which can be handled like those of canning peas. They produce large, dark-green peas, usually associated with market varieties. Hundredfold, Laxtonian, and Progress are all popular in places where early varieties can be used, but the short vines are not so suitable for viners as are those of Thomas Laxton. When Thomas Laxton is not available, good use has been made of World Record, Stella, Banqueter, and Gradus.

Of the early midseason varieties, Morse Market, Gilbo, and President Wilson have been popular. For the later midseason, Giant Stride and Stratagem are favorites. Alderman, Dark Podded Telephone, V C, and Quite Content are unsurpassed for quality. For high yields these last four varieties should be grown on poles or trellises, but these varieties are grown without support at present, as hand labor is not available for picking.

There is a geographical distribution of varieties, but any good pea-growing section may occasionally grow some of nearly all freezing varieties. The later midseason peas are usually most popular in the West where the growing season is longer, while Thomas Laxton and other early varieties are popular in New Jersey, Delaware, and Maryland.

SEEDING

Seed should be procured from a reliable source, as it is to the processor's best interest to provide the best quality as well as the best varieties of pea seed. The stock seed from which the commercial supply is grown should be from pure-line plants increased under conditions of isolation or from ones that have been carefully rogued. It is not wise for the processors to demand commercial seed that has been rogued, since this operation is very expensive when properly done. It is much better to obtain from the seedsman a statement about percentage and types of rogues found in the seed stock used for increasing the seed for planting the processing crop. It is best to make a germination test of the purchased seed early in the spring to determine the proper quantity to sow. Both the processor and the grower should guard against mixing seed of early and late varieties. It is not recommended that growers of peas for canning or other commercial processing attempt to grow or save their own seed supply, as the production of high-grade seed is a specialized industry confined to particular localities of the West where conditions are favorable.

In attempts to prolong the harvest season, successive plantings of peas are frequently made at intervals of several days. This is to be discouraged for two reasons: (1) A difference of several days between planting dates usually makes very little if any difference in the date of maturity of the crop; and (2) in general, delaying planting beyond the earliest practicable dates results in decreased yields. These results are especially striking in regions that warm up quickly in the spring, but they also occur in the more northern States. Early planting is important. The actual dates will of course depend upon the locality, the weather, the soil conditions, and the variety.

Peas should be sown as early as the soil can be worked into good condition and there is little probability of a freeze after the plants have attained a height of several inches. Moderate frosts rarely harm peas when they are small. The smooth-seeded varieties are

usually sown first, since they are considered more hardy than most of the wrinkled-seeded varieties.

The best practice is to use either a grain drill or a special pea seeder for planting the crop. The use of this type of equipment gives better results than can be had by sowing the seed broadcast and harrowing or plowing it in, as the seed is all placed at a uniform depth and is uniformly distributed. Seedings should not overlap, and some space should be left between two varieties when they are planted in the same field. Sometimes the land is rolled after the seed is sown.

The quantity of seed to be sown per acre depends on the variety used, the quality of the seed, the character of the soil, the preparation of the seedbed, and other factors. Standard quantities are $3\frac{1}{2}$ to $4\frac{1}{2}$ bushels per acre of Alaska and 4 to $4\frac{1}{2}$ bushels of the wrinkled-seeded varieties. Some growers have obtained larger yields through heavier rates of seeding, the profitable limits of which must be determined by the grower. The quantity of seed should be sufficient to prevent the growth of weeds and grass but not so heavy that the plants will crowd one another. A good depth is $2\frac{1}{2}$ to 3 inches; this depth gives as a rule the highest percentage of germination and the greatest yield. The depth is partially governed by the character of the land, light soils requiring deeper seeding to prevent excessive drying out. The earlier plantings should be shallower than those made later. The time of maturity is not materially affected by the depth of planting.

In general, rates of seeding are much lighter in the West than in the East. If peas are sown on dry lands dependent upon rainfall, the moisture available will not support plants from more than 2 or 3 bushels of seed per acre. On irrigated soils proper application of water to the pea crop increases the yield considerably so that planting rates are somewhat less than for the East.

In order to reduce the proportion of vine to shelled peas and to facilitate handling, many of the peas grown for freezing are planted in rows with seeding rates of 30 to 60 pounds per acre.

CONSERVING THE SEED SUPPLY

During seasons of short seed supply or great demand for seed on account of an expanded acreage, the available supply of seed can be made to go farther by planting in rows. On clean land where cultural facilities are available only about one-fourth as much seed is required in order to get the same yields by the row method as when the seed is sown broadcast or with a grain drill. Row planting also makes it possible to grow some of the bush varieties, such as Little Marvel, which are not ordinarily used for canning on account of shortness of stems, but which if planted in rows and cultivated may be quite satisfactory. Other varieties suitable for row planting are Canner's Gem, Premium Gem, and others in the Gem group. Almost all the canning varieties are adapted for planting in rows except the early straight-stemmed sorts such as Alaska and Surprise. Certain varieties that produce an excessive vine growth when sown broadcast or with a grain drill can be satisfactorily handled in rows. When peas are grown in rows the production of shelled peas is usually as great as that of those sown by the grain drill or broadcast method, and the cost of cultivation is not high since not more than two or three cultivations are required to bring the crop to the canning stage. During

seasons when moisture shortage is encountered, midseason varieties such as Perfection and Prince of Wales may give a much better yield in rows than with ordinary planting.

The spacing of rows should vary with the variety; for example, Little Marvel may be grown in rows $1\frac{1}{2}$ to 2 feet apart, while the larger growing varieties will require rows spaced 2 to 3 feet apart. A good general rule is to space the rows so that the plants will touch across the rows when in full bloom. The proportion of shelled peas to total weight of vine is usually greater when the peas are planted in rows than when they are sown broadcast or in drills; consequently, the total bulk to be transported to the vining station and to be passed through the viner is less with the row method of culture.

WEED CONTROL

The land should be rolled or planked immediately after the seed is sown. This compacts the seedbed and makes a smooth surface upon which to operate the mower at harvesttime. Just before the peas begin to break through the soil it may be advisable to run a shallow weeder over the land in the same direction as the drill. This is done when the land appears weedy or when the soil has a tendency to bake.

When drill-sown, the pea, like some cereals, is not usually cultivated. The crop starts quickly and makes rapid growth, usually preventing most weed competition. Newly acquired or poorly managed land in some sections of the country may be so completely infested by the annual wild mustard that the pea crop will be seriously injured. Some effort has been made to control this weed by the use of chemical sprays; but to date no effective substitute for thorough culture and good field management, as a means of controlling weeds, has been discovered. If the Canada thistle is prevalent it is advisable to go through the fields and cut the buds and blossoms just before the harvesting of the peas. These parts then dry up and fall to the ground. If not cut, they will thresh out with the peas and, being of the same size and weight, will pass through the factory machinery with the shelled peas. While cutting the thistle, one can pull the larger weeds, like milkweed, without damaging the pea crop.

INSECT PESTS ⁴

The pea crop is subject to the injurious attacks of certain insect pests. Among the insects that may cause damage are the pea aphid ⁵ and the pea weevil.⁶ The aphid is perhaps the only insect that makes serious inroads on the growing of green peas. The aphid can be controlled in part by the observance of those measures mentioned under rotations (p. 4) and by the use of natural enemies. The presence of the weevil should be noted, so that proper allowance may be made at the time of planting for infested seed. Weevil-infested seed may give a germination as low as 30 percent. The pea moth, which feeds within the pods on the ripening peas, has made its appearance in northeastern Wisconsin and is reported from Michigan. It is a serious pest in Canada.

⁴ Information on the methods to be employed for the control of the pea moth and other insects can be obtained from the Bureau of Entomology and Plant Quarantine, U. S. Department of Agriculture.

⁵ Farmers' Bulletin 1853, The Pea Aphid on Peas and Methods for its Control.

⁶ Farmers' Bulletin 1275, Weevils in Beans and Peas.

PEA DISEASES AND THEIR CONTROL ⁷

The pea plant is subject to attack by a number of different parasites, of which some cause serious losses to the crop and others are of little or no economic importance. The diseases of peas may be divided roughly into two general groups: (1) Those that attack parts of the plant above ground and (2) those that are restricted to the roots and stem. Leaf diseases are usually not very serious, and remedial measures are seldom necessary.

The diseases of the second group include the root rots and wilts. The root rots are caused by several different fungi that cause decays of the primary and lateral roots, thereby shutting off the movement of food material from the roots to the above-ground parts of the plants. The wilt organisms invade the vascular bundles of the stem and stop the flow of water through the stem to the leaves. Against the root rots and certain leaf diseases only preventive measures are practicable.

USE OF CLEAN SEED

Two or three important pod and foliage diseases, generally spoken of collectively as blights, may be carried and distributed by the seed. Although it may not always be possible to designate the source of seed to be sown, seed grown in the West, especially west of the Rocky Mountains, is preferable. Such seed may not be absolutely free of disease-producing organisms, but it is much more likely to be than seed grown in the Central or Eastern States.

SEED TREATMENT

Seed treatment is practiced to some extent. The results have been too variable and uncertain for it to be recommended generally. The most beneficial results are likely to be obtained in very early planting if the soil is wet and the weather cool. Under such conditions a disinfectant, such as cuprous oxide or 2-percent Ceresan, may protect the seed from rotting until it has a chance to germinate. Sperguson, which has given satisfactory results under certain conditions, may be used as a substitute when the copper or the mercury compound is not obtainable. It should be used according to the manufacturer's directions. Seed treatment may be of little benefit if the weather is sufficiently favorable for quick germination.

CROP ROTATION IN RELATION TO DISEASE CONTROL

The value of crop rotation as a means of disease control has frequently been overestimated. Many disease-producing organisms live a long time in the soil even in the absence of the pea plant or other susceptible hosts. Some of the organisms causing root diseases of peas can live almost indefinitely on the decaying vegetable matter of almost all plants. In view of this fact, eradication by means of crop rotation must not be expected. Experiments have shown, however, that some reduction in crop losses and in the amount of disease is obtained if the rotation is not too short.

If peas have been grown on the soil several years in succession and root rots and other diseases have become troublesome, it is advisable

⁷ For more complete information, see Farmers' Bulletin 1735, Pea Diseases and Their Control.

to adopt a system, if possible, that will bring peas on the same land not oftener than once every 4 years. Unless crop rotation (p. 4) is a general farming practice, the grower should study conditions in his own field, and, when the yields appear to be affected, the rotation should be started the next season. Legumes should be omitted from the rotation program whenever possible.

RESISTANT VARIETIES

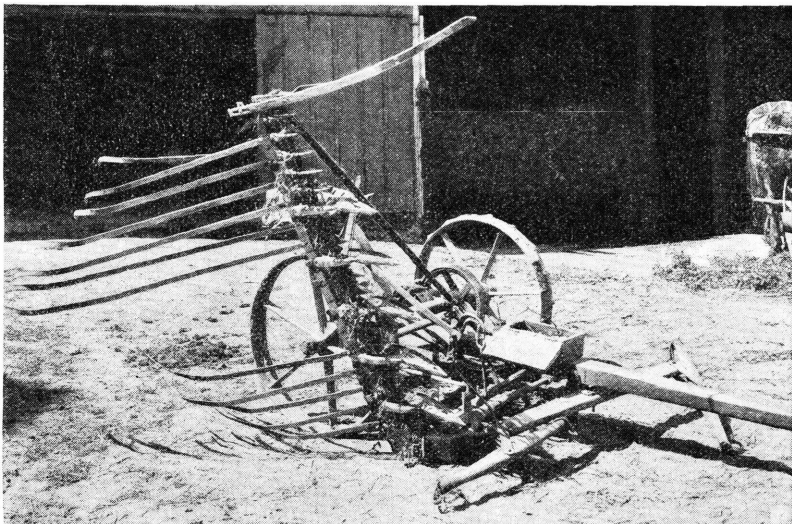
The diseases caused by wilt-producing organisms can be controlled in part at least by the use of wilt-resistant varieties. A number of such varieties, some of which may be adapted to local conditions, have been developed in recent years and placed on the market. Most of the pea varieties now sold for canning are resistant to fusarium wilt, although wilt is not a problem in many canning sections. The canning varieties mentioned on page 9 either are entirely wilt-resistant or are sold in both resistant and susceptible strains, of which the resistant is the more important.

Early wilt-resistant varieties include Wisconsin Early Sweet, Mardelah, New-Line Surprise, and several strains of Alaska. Mid-season wilt-resistant varieties are Ace, Climax, Canner King, Epicure, Early Kay, Gradah, Pride, Wisconsin Penin, Early Wales, Early Perfectah, and Early Perfection. There are also several strains of wilt-resistant Perfection now available, maturing at the same time as wilt-susceptible strains.

HARVESTING

The importance of early planting in relation to harvesting may be emphasized again because a greater spread in the harvesting of different fields sown at the same time usually results, and because early-sown peas make most of their growth during the cooler weather, approaching maturity less rapidly than late-sown peas. These con-

FIGURE 2.—A mowing machine fitted with lifting guards and a swather or windrowing device, as used for cutting peas.



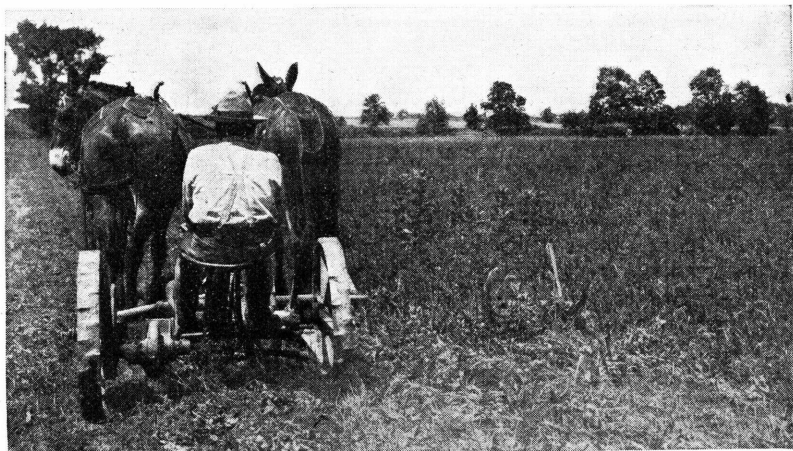


FIGURE 3.—Cutting peas with a mowing machine fitted with lifting guards and a windrowing device.

ditions permit much better opportunities for a timely harvest. Late-sown peas, especially in the more southerly pea-growing States, remain in prime harvesting condition such a short time that it is often impossible to harvest a large acreage before the quality has become very poor. The more gradual development of early-sown peas is, of course, an important factor in preventing serious congestion at viner stations and factories.

The time for harvesting is determined largely by the appearance of the pods. These should be swollen and well filled with young succulent peas and changing in color from dark to light green. By that time the vines have attained their full growth, and the stem, which retains all of its leaves, is still succulent. It is the aim to harvest the peas at a time when a high yield will be obtained while the peas are still in prime condition.

As the peas approach the time of harvest the fields should be carefully watched to see that the crop does not pass prime condition. This inspection should embrace all parts of the field, since some spots may ripen before others, owing to soil and other differences. Sometimes it is necessary to cut one portion of a field before the rest. This thorough examination is especially necessary during wet seasons, to guard against the development of a second growth of the peas. If the weather continues moist when the crop has nearly reached maturity the pea vines will begin to lodge. These plants will then send out new shoots, which grow upward and begin to flower. The main crop may be fully mature, while the upper portions of the vines are in blossom. If the harvesting is delayed it may mean the loss of the main crop in favor of the second growth, the yield of which would be negligible. The exact day of harvest is determined by an agent of the processor, who directs that the peas be cut and delivered to the factory. This demands the closest cooperation between the grower and the processor, in order that the peas may be harvested and hauled to the factory only as fast as they can be used.

An ordinary mowing machine, fitted with special vine-lifting guards and swather (fig. 2), is usually used to cut the crop. These



FIGURE 4.—A side-delivery rake in use in a pea field.

guards are big-fingered attachments placed on the cutter bar of the machine; they lift the vines off the ground so that the crop is cut off close to the soil. After the vines are cut they are rolled by the swather, or bunching device, and are dropped at the rear (fig. 3), leaving the pea vines in a neat windrow in the middle of the swath. When using the ordinary mower it is necessary to fork over the material from each swath as it is cut, in order that the pea pods may not be broken by the hoofs of the horses or by the wheels of the mower on the next round. When the vines are very heavy it is sometimes necessary that a man with a hay fork follow the mower and assist in removing the matted mass. The vines should be handled as little as possible after they are cut.

The vines are usually mowed early in the morning or late in the afternoon, especially when the weather is very warm. Only the quantity that can be hauled quickly should be cut at one time. The sun and high temperatures cause the vines to wilt when lying on the ground or to heat when bunched in piles and during transportation. Heating is more likely to occur when large quantities of weeds are intermixed with the peas.

The labor required in harvesting peas depends upon the available equipment. Under ordinary conditions the area of the peas to be cut in any one day should be restricted to the quantity that can be hauled by the available labor and equipment.

LOADING AND TRANSPORTING

Peas may be loaded directly on wagons or trucks from the swath, or they may be raked with a side-delivery rake (fig. 4) and loaded from the windrow. The latter method saves labor, but the additional handling may be somewhat injurious to the peas. The vines are immediately hauled to the processing factory or to a field vining station. They are usually loaded by hand on a wagon provided with hayracks, but occasionally a hay loader can be used. The wagons should not be loaded until the grower is sure that he will be able to haul them directly to the viner. Auto trucks, which are better than

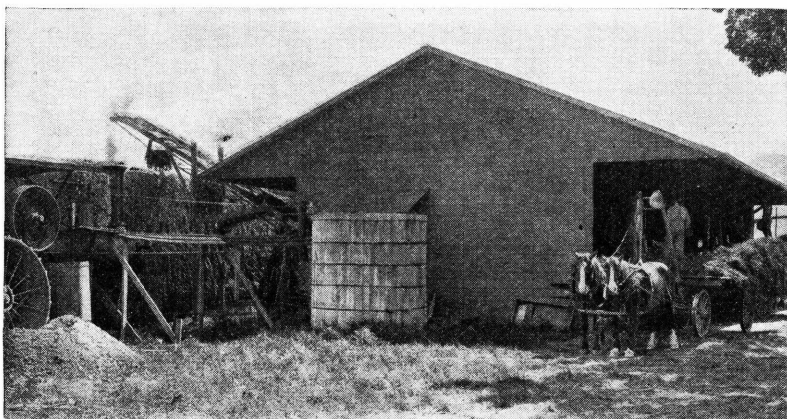


FIGURE 5.—Vining station used to shell peas grown at a distance from the factory. This procedure makes it unnecessary to haul a heavy tonnage of vines long distances.

wagons for long hauls, are now used where field and road conditions permit.

In order to avoid the hauling of large quantities of vines over long distances to the factory, the plan of establishing vining stations has been adopted in many sections. This enlargement of facilities enables the processing companies greatly to extend their sphere of operations, for it is possible with the aid of trucks to haul the shelled peas for several miles to the factory. These vining stations consist of one or more viners installed in a simple type of building and operated by a portable engine (fig. 5). One of these stations usually handles the pea crop of several farms.

Processors who attempt to retain as much quality as possible in their frozen products have successfully cooled peas at the viner stations by use of cold air or cold water and have hauled them to the factory on trucks having some cooling facilities.

Whether delivered to the main factory or to a field viner, the peas should be vined immediately. When it is impossible to handle a load or two late in the day, the vines should be kept spread out in thin layers to prevent heating. The use of the field vining stations demands the rapid handling and transportation of the shelled product. After shelling, the peas should not be allowed to stand overnight but should be canned or frozen as soon as possible. The whole process of harvesting and handling the pea crop requires the utmost dispatch if a good canned or frozen product is to be prepared.

YIELDS, COSTS, AND PAYMENT

The yield of peas to the acre varies with the variety and the conditions under which the crop is grown. The average yield of green peas for processing in the United States during the 10-year period from 1929-38 was 1,518 pounds of shelled peas per acre. For 1939 the yield was 1,570 pounds, and for 1940 it was 1,855 pounds per acre.

As a general rule, the yield of the smooth or early varieties of peas is smaller than that of the wrinkled or late varieties. From figures gathered during the past several years in the States of New York and Wisconsin, it has been found that the yields of the early varieties range from 860 to 2,400 pounds per acre and of the late varieties

from 1,000 to 3,250 pounds per acre. The average price of shelled peas as received by the growers during the 10-year period from 1929-38 was \$51.53 per ton.

The profits per acre depend upon the yield per acre, cost per acre, and the prices paid by the processing firms. These profits may vary from that from a poor crop, where the cost of seed, labor, etc., are scarcely met, to \$50 to \$75 per acre. The cost of growing peas depends upon the rental of the land, the character of the soil, the cost of the labor, seed, and fertilizer, the sowing of peas, and other items. With the exception of the cost of seed, these should not differ greatly from the cost of an ordinary grain crop. It does, however, cost more to harvest the crop, owing to its great bulk of vines. The cost of hauling is an additional factor. As these factors vary in the different sections of the country, no definite figures can be given.

The basis upon which payment for the crop is made varies in different sections and with different processors. Some processors pay a flat rate per bushel or per 100 pounds of shelled peas. A second method is to pay graduated prices, as gaged by an inspection of each load of peas. The third system is to pay one of several prices, according to the percentage of peas of a certain size and of a certain quality, as indicated in a sample from each load of peas. The principle of this test is that small size is associated with immaturity and tenderness. The fourth scheme is based on a sample of peas taken from the vines and its division into the five customary factory sizes. Payment is made on the percentage basis of each size or combination of sizes. The fifth plan considers the effect of gravity on a sample of shelled peas in a series of brine solutions. This test separates the peas on the basis of quality rather than size. The sixth method is a crushing test of the shelled graded or ungraded peas with an instrument called the tenderometer.

In the first instance the processor insists that the peas be delivered as young as it is profitable to use them. The farmer, however, finds it to his advantage to delay delivery to obtain an increase in growth and weight of the product. This method affords no extra returns for a superior crop. The ratings in the second method are a matter of judgment on the part of the inspector. The third system provides payment according to the one grade of size and quality that may be assigned from the examination of the load. The fourth scheme is more accurate, since payment is made on the mechanical grading of the crop, the smallest peas receiving the highest premium. The fifth plan considers quality as the basis upon which to make payment, but it is a time-consuming method. The sixth method is perhaps now the most important and popular. It is a quick and dependable method. The readings are based on the increase in resistance to crushing as peas progress toward maturity.

The United States Standards for Grades of Canned Peas and Frozen Peas, issued by the United States Department of Agriculture, defines the sizes of peas as follows:

- No. 1 size peas are peas that will pass through a screen $\frac{3}{32}$ -inch mesh.
- No. 2 size peas are peas that will pass through a screen of $\frac{1}{32}$ -inch mesh, but not through a screen of $\frac{3}{32}$ -inch mesh.
- No. 3 size peas are peas that will pass through a screen of $\frac{1}{32}$ -inch mesh, but not through a screen of $\frac{1}{32}$ -inch mesh.
- No. 4 size peas are peas that will pass through a screen of $\frac{1}{32}$ -inch mesh, but not through a screen of $\frac{1}{32}$ -inch mesh.

No. 5 size peas are peas that will pass through a screen of $1\frac{1}{32}$ -inch mesh, but not through a screen of $\frac{1}{2}$ -inch mesh.

No. 6 size peas are peas that will pass through a screen of $\frac{1}{4}$ -inch mesh, but not through a screen of $\frac{1}{8}$ -inch mesh.

No. 7 size peas are peas that fail to pass through a screen of $\frac{1}{4}$ -inch mesh.

The return of the vines as hay or silage may also enter into the question of fixing prices for peas.

VINE DISPOSAL

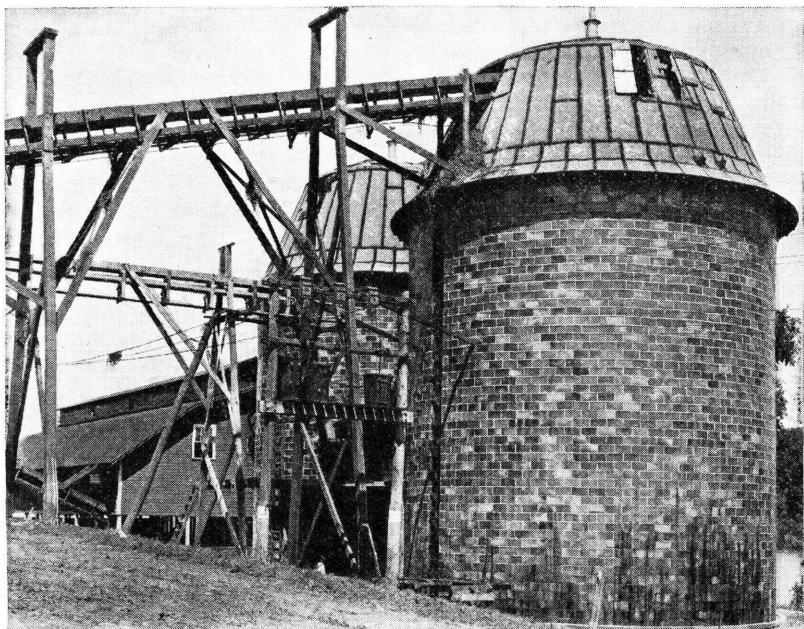
Large quantities of vines remain after the peas are vined. Formerly this material was considered worthless and a nuisance. The processors paid the farmers to haul it away for manure, or it was left in piles to decompose. The dumping of pea vines in large quantities soon led to the discovery that a large percentage of the vines thus handled was preserved like silage and greedily eaten by livestock. These vines are now considered a valuable byproduct, but in some regions this material is being wasted because its feeding and manurial values are not fully appreciated.

Freshly gathered vines may be used in their natural state as green feed, and as such they are probably equal to any other soiling crop. Because of the bulky nature of this material it must be used near the factory or vining station.

Curing the vines for hay may be practiced under favorable conditions. However, the labor involved in spreading and turning the vines in curing makes it an expensive way of handling the material.

There are two general methods of making silage, either by constructing stacks or by using silos. When a limited quantity (from 50 to 75 tons) is to be handled by one person, the silo will prove most satisfactory, although some canneries have one or a battery of silos,

FIGURE 6.—Silos used for preserving pea vines.



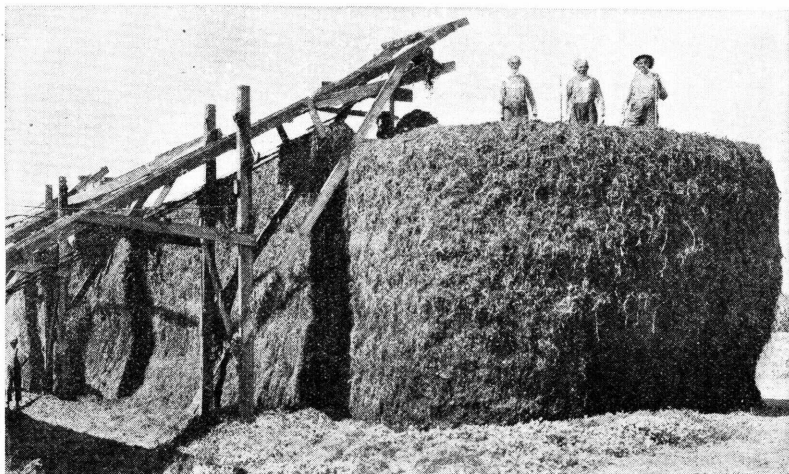


FIGURE 7.—A partly completed stack of pea vines at a vining station.

each holding up to 200 tons (fig. 6). Silos for the individual grower are common in dairy sections.

Pea vines may be stacked according to the methods used in putting up hay, straw, etc. The stacks themselves may be of any size and are frequently 80 feet long, 20 feet wide, and as high as it is convenient to build them (fig. 7). Many vines are equipped with carriers that permit the building of stacks 20 to 25 feet high. Owing to the large moisture content of the pea vines, a considerable quantity of juice exudes from the bottom of the stack or silo. Suitable drainage should be provided to carry off the surplus juices. The larger the pile and the better compacted, the smaller will be the proportion of spoiled material. Under normal conditions only the outer 8 to 12 inches should decompose.

When a silo is used, the vines are placed therein just as they come from the viner, or this material may be shredded through a silage cutter. The pods and vines are usually run into the silo by the use of a conveyor. As a rule, well-trampled pea silage will not shrink perceptibly, and only a limited quantity will spoil. Pea vines kept in silos can be removed and used with a minimum of waste. Although the cost and maintenance of the silo amount to a considerable sum, the value of the vines saved will soon pay for the investment.

The manner of disposing of the green pea vines, the pea hay, and the silage varies. Some processors offer these materials free to induce the farmers to grow peas. In some cases the farmer is allowed the weight of green vines brought to the factory less the quantity of peas threshed, or it may be prorated on the basis of shelled peas produced. At other factories the canners or freezers reserve the material for their own feed lots. Sometimes a farmer or a stock-feeding concern may contract for all the refuse. In cases where the factory makes silage, this silage supply may be prorated among the farmers who produce the original material. It may sometimes be sold back to the producers, and any excess to nonproducers to whom, however, a higher price is charged. The making of silage by the factory may be an advantage to the producer, since he can haul the material in the slack winter season.

The yield of vines varies with the variety, the soil, and the seasonal conditions, the average from an acre of peas approaching 3 tons, although there may be yields as high as 10 tons. On the market, silage made from these vines varies in price from year to year, as do all feeding materials. The value of pea vines as a feed for livestock is sufficiently great to warrant the expenditure incurred in providing facilities for handling and storing the vines by such methods as will result in reducing the waste to a minimum.

FEEDING PEA VINES AND PEA-VINE SILAGE

Peas grown in a dairy or a livestock section in many instances produce large quantities of desirable feed materials that may be used in the green state, as hay, or as silage. Pea silage is especially valuable for late-summer feeding when pastures are short and before new corn silage is available. The same precautions observed in feeding corn silage should be followed in the feeding of pea silage to dairy cattle, for milk absorbs the strong odor when kept in proximity to the silage. It would seem best not to feed in too large quantities and to place the silage in the manger shortly after milking and also to see that the barn and manger are free of the material at milking time. Sometimes beef cattle are wintered on pea silage exclusively, but often it may be supplemented with sweet-corn stover and other materials produced on the farm. Processors frequently winter large herds of stock, using pea silage for the greater part of the ration, and many have found this profitable. In some communities the processors run boarding stables for cattle buyers during the winter months. Pea-vine silage has become highly regarded in Wisconsin and New York as a winter feed for sheep. The hay has been used as roughage for work horses and mules during the winter months.

VALUE OF PEA VINES AS MANURE

The pea as a cover crop returns a large quantity of green matter to the soil. In cases where it is not profitable to harvest the pea crop for canning, as after a destructive infestation of aphids, the vines may be turned under, adding materially to the plant food and humus in the soil. The outer layer from the stack is often used as an orchard mulch. Orchardists realize that this pea-vine waste is an excellent humus source, and in some localities there is great demand for this material. In other cases the lower layer soaks up the liquids that drain from the stack. This material must be allowed to decompose, for if used while fermenting this refuse may cause serious injury to the crop to which it is applied.

When the pea vines are completely rotted, they have a fair fertilizing value, but it will perhaps be found to be even better if the roughage is first fed to stock, as only a small portion of the fertilizing constituents need be lost in animal feeding. The manure can then be applied to crops and a double return obtained. Care, however, should be exercised to avoid the use of animal manures that have been produced as a result of feeding diseased pea vines or silage made from diseased vines. The refuse material from around the outside of silage stacks should not be spread on land that is to be used for growing peas, as it is a potent carrier of disease-producing organisms.